

The UN Secretary-General's Advisory Board on Zero Waste

Ore Sand: A Circular Economy Solution to the Mine Tailings and Global Sand Sustainability Crises



Zero waste good practice

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Citation: UN SG's Advisory Board on Zero Waste. (2024). Ore Sand: A Circular Economy Solution to the Mine Tailings and Global Sand Sustainability Crises. The University of Queensland & University of Geneva.

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About

Synopsis

Ore-sand is a manufactured sand produced as a by-product of metal ore mining that has the potential to drastically reduce mine wastes and the demand for natural sand.



Sampling point for ore-sand at Vale's Brucutu iron ore processing plant

Implementation
period

2019 - now

Country

Brazil

Location

Belo Horizonte

Stakeholders and Partners: The University of Queensland; The University of Geneva; Federal University of Minas Gerais; Vale S.A. Mining Company

Connection Zero Waste

Vale, with the support of its partners has implemented a circular economy initiative to reduce tailings waste production by adding mineral processing at its Brucutu iron-ore mining to extract ore-sand by-products for use in the local construction sector. Around 1 million tonnes of tailings has been reduced as a result of the initiative to date, with transformative implications for the global mining sector.

The approach reduces the environmental and social risks of traditional mining activities, such as habitat destruction and water pollution, while also addressing the growing demand for construction materials in a sustainable manner.

Contribution to Sustainable Development Goals

Goal 12 (Target 12.2, 12.5, 12.6):

Target 12.2: The initiative promotes efficient natural resource use, and reduces the demand for new mineral extraction.

Target 12.5: Ore-sand minimizes waste by efficiently using the minerals present in the ore.

Target 12.6: Though not its primary aim, the initiative fosters sustainability by mine waste management, indirectly promoting sustainable practices.

Goal 13 (Target 13.1)

The initiative indirectly strengthens resilience to climate-related hazards by mitigating environmental impacts of mining, reducing factors contributing to climate change.

Goal 6 (Target 6.3 and 6.6)

While not its main focus, the initiative helps improve water quality and protect water-related ecosystems by reducing pollution and habitat destruction from tailings storage facilities.

Goal 9

Ore-sand is a source of sustainable construction materials for infrastructure development.

Background, Challenges and Objectives

Objective: The aim of the initiative is to investigate whether by-products of mineral ores, with favourable mineralogical and physicochemical characteristics, can be a viable and sustainable source of substitute aggregate material for construction and other industries, and reduce the rising demand for sand extracted from the natural environment.

Relevant background of Minas Gerais, Brazil: Brazil's mining history, coupled with its dense population and high demand for construction materials, underscores the need for sustainable resource management. Minas Gerais, a populous state with significant mining activity, is a prime candidate for this initiative. Recent iron ore tailings dams disasters in 2015 and 2019 Minas Gerais have spurred investment in circular economy strategies, highlighting the urgency of innovative mine waste management.

Challenges and opportunities: By producing ore-sand materials the initiative aims to reduce tailings volume and meet sand demand sustainably, addressing environmental concerns and enhancing social acceptance of mining activities.

Choice of approach: The initiative demonstrates a commitment to addressing multiple sustainability issues by exploring the potential of sand by-products to manage tailings and meet sand demand sustainably.

“Exploring the potential of mineral ore by-products not only offers a sustainable solution to meet construction industry demands but also addresses environmental and social concerns surrounding mining activities.”



Vale ore-sand

Actions and Implementation

In our actions and implementation chapter, we outline the steps taken to achieve sustainable waste management:

The case study represents a wide range of actions over a multi-year period.

The initial concept was advanced experimentation, pilot production and full-scale implementation at Vale's Brucutu mine in Minas Gerais. A range of studies were undertaken to advance and verify the work with University partners. The case study was featured in UNEP's Sand and Sustainability report in 2022. Full-scale implementation has been demonstrated with major mine waste reductions and use of ore-sand in road-building, brick making and concrete applications.

Outcomes and Impact

The comprehensive evaluation of ore-sand production and utilization has yielded significant insights into its potential as a sustainable solution to the intertwined crises of mine tailings management and sand sustainability. Through rigorous analysis and stakeholder engagement, several key findings and recommendations have emerged, highlighting both the successes and challenges of implementing ore-sand strategies. The project outcomes underscore the viability of ore-sand as a promising alternative to naturally occurring sand in various applications. By strategically aligning mineral processing operations with the production of ore-sand, significant progress has been made in meeting quality specifications for construction aggregates. However, to fully realize the potential of ore-sand, several recommendations are proposed:

- Engaging diverse stakeholders, including industries, standard-setting institutes, and local communities, is essential for driving the adoption of ore-sand. Cross-sectoral dialogue can facilitate the development of innovative market strategies and regulatory frameworks conducive to ore-sand utilization.
- Continued research and development efforts are necessary to address technical limitations and optimize ore-sand production processes. Innovations such as coarse grinding and particle flotation offer promising avenues for enhancing ore-sand quality and expanding its applicability in various construction and industrial sectors.

Replicability and Scaleability

Analysis has been undertaken to identify and model the global replicability of the initiative with major global reduction of mine tailings possible. The University of Queensland has also worked with other mining partners (e.g. Newmont) to demonstrate the applicability to other ore body types and improve the properties of the sand. The initiative is scaling up both through the University of Queensland and Vale's spin off company Agera.

Inclusion and Innovation

The initiative involves collaboration between mining company, universities, and government agencies. Mining companies play a key role in implementing the initiative, while government agencies provide regulatory oversight and support. Universities are engaged through consultations and research.

Innovation Methods include:

- 1. Relative advantages:** the degree to which ore-sands are considered better than the preceding product, technology, concept or approach by key stakeholders in the context of market conditions.
- 2. Compatibility:** the degree to which an innovation is perceived as being consistent with existing organizational goals, current or future technical and legal constraints, values, past experiences, and needs of the potential adopters and broader social goals.
- 3. Complexity:** the degree to which an innovation is considered as difficult to understand and use.
- 4. Trialability:** the degree to which new ideas or innovations can be experimented for a limited time ahead of making larger commitments.
- 5. Observability:** the degree to which the results of an innovation become clearly visible to decision makers and stakeholders within organizations and in industry sectors.

Accountability and Sustainability

Life cycle assessment and other types of analysis have been performed to ensure sustainability. Full and independent sampling and characterisation has been performed.

See major study on Vale ore-sand here: https://smi.uq.edu.au/files/83107/FinalReport_OreSand_v1.pdf

See study on Newmont (Newcrest) ore-sand here: <https://espace.library.uq.edu.au/view/UQ:96249f6>

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Also consult the report under https://smi.uq.edu.au/files/83107/FinalReport_OreSand_v1.pdf